A Clinical Survey of 415 Instances of Brain, Spinal Cord and Peripheral Nerve Injuries, as Seen in Overseas Wounded

With Reports of Several Unusual Cases

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A CLINICAL SURVEY OF 415 INSTANCES OF BRAIN, SPINAL CORD AND PERIPHERAL NERVE INJURIES, AS SEEN IN OVERSEAS WOUNDED

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The cases constituting the basis of this report were studied at the U. S. Army Base Hospital, Camp Merritt, N. J., during the period from December, 1918, to March, 1919. As this institution evacuated the wounded to hospitals of the interior, the treatment given these patients during their brief stay was of a temporary nonsurgical nature. As a consequence, no therapeutic deductions were made from the treatment applied to this group of cases. The tables appended (Tables 1, 2 and 3) give a detailed analysis of the cases.

The 415 instances occurred in 328 patients, 76 of whom had two or more lesions. Of these multiple injuries, which occur with much greater frequency in lesions of the upper extremities, the commonest combinations are analyzed in Table 2.

These cases have been examined at this hospital, on an average of from three to five months after the original injury was sustained; therefore, a sufficient length of time has elapsed to allow of the completest evolution of the lesion. On the other hand, in certain brain and cord injuries (namely, aphasias and hematomyelias) a marked degree of recovery has been attained in that period of time; in such cases, history and field cards have corroborated the diagnosis.

PERIPHERAL NERVE INJURIES

In Tables 1 and 2 it will be noted that three columns have been drawn — one to indicate complete severance and loss of function of the nerve; a second, to indicate incomplete severance, contusion, concussion or commotio of the nerve, with incomplete loss of function, and a third, those cases of an incomplete nature, in which the pain or

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* Authority to publish granted by the Board of Publication, Surgeon-General's Office.

TABLE 1.—Statistical Data on 415 Nerve Injuries

Nerve Involvement	Complete Involvement	Partial Involvement	Neuritis Causalgia	Total
Brachial plexus	2	7* 2	5	16
Root lesions	3	..	..	3
Cord lesions—				
Outer	1	..	..	1
Inner	5	..	..	5
Posterior	..	2	..	2
Median	35	27	8	70
Ulnar	43	24	8	75
Musculospiral	37	12	4	53
Radial (term. cutan. branch of musculospiral)	8	..	..	8
Internal cutaneous	8	1	1	10
Circumflex	4	..	..	4
Musculocutaneous	3	3	..	6
Long thoracic	1	..	..	1
Nerve to rhomboids	1	..	..	1
Nerve to posterior axillary muscles	1	..	..	1
Total	152	78	26	256
Sciatic	12	4	5	21
Small sciatic	2	..	1	3
External popliteal	33	6	1	40
Internal popliteal	1	4	1	6
Posterior tibial	4	3	4	11
External cutaneous of thigh	3	..	..	3
Internal saphenous	2	1	2	5
External saphenous	1	..	..	1
Anterior crural	..	..	2	2
Total	58	18	16	92
Cranial Nerve Injuries—				
Olfactory	..	..	..	0
Optic	6	1	..	7
Oculomotor	2	3	..	5
Trochlear	..	..	..	0
Trigeminal	..	4	..	4
Nerve to external rectus	1	1	..	2
Facial	4	7	..	11
Auditory	2	2	..	4
Glossopharyngeal	..	..	..	0
Vagus	..	1	..	1
Spinal accessory	..	2	..	2
Hypoglossal	1	1	..	2
Total	16	22	..	38

* Commotio of plexus with residual lesions.

TABLE 2.—The Most Common Combinations in Multiple Lesions

Nerve Involved	Complete Involvement	Partial Involvement	Neuritis Causalgia	Total
Median and ulnar	9	8	2	19
Median and musculospiral	1	..	..	1
Ulnar and musculospiral	1	1	..	2
Median, ulnar and musculospiral	5	3	1	9
Median, ulnar and internal cutaneous	3	..	..	3
Median and radial	3	..	..	3
Median, musculospiral and internal cutaneous	1	..	..	1
Median, ulnar and radial	1	..	..	1
Total	24	12	3	39

causalgia have been of predominating severity. In the column of "partial involvement" are also included those cases in which only the sensory or motor components of a mixed nerve have been involved.

In regard to peripheral nerve injuries, comparison of our statistics with those of recent English writers (namely, Burrow and Carter,[1] and Stewart and Evans[2]), reveals on the whole a close correspondence; certain discrepancies, however, require comment. These authors have found brachial plexus injuries more commonly than we have; namely, Burrow and Carter, 77 out of 1,000 cases, and Stewart and Evans, 61 out of 316 cases.

TABLE 3.—Brain Injuries—Secondary to Fractured Skull

Brain Injuries—Secondary to Fractured Skull—	
Aphasias (motor and sensory) partial	7
Hemiplegias	4
Paraplegias	1
Astereognosis (injury to superior parietal lobe left)	1
Occipital lobe injuries (with hemianopsia)	2
Posttraumatic (fracture) psychosis	1
Total	16
Spinal Cord Injuries—	
Hematomyelia (concussion)	4
Cauda equina	3
Conus terminalis	1
Cervical sympathetic palsy	1
Segmental lesions:	
Cervical	1
Dorsal	0
Lumbar	1
Sacral	2
Total	13

In studying the histories of the severer injuries of the upper arm and shoulder, commotio of the brachial plexus has been noted very often. In fact, the great majority of men sustaining severe wounds of the upper arm and shoulder give a history of a fairly complete sensory and motor paralysis of the corresponding arm, occurring directly after the injury. This paralysis quickly improves; many finally achieve complete restoration of function, others show residual sensory and motor lesions.

In their combined total of 1,316 cases, circumflex nerve involvement occurred twice, whereas, in our series four instances are recorded, three of which occurred singly. Our one case of long thoracic nerve involvement (associated with a commotio of the branchial plexus) and our one instance of involvement of the nerves to the rhomboidei, find no parallel in their series. Of our ten lesions of the internal cutaneous

1. Burrow, J. LeF., and Carter, H. S.: Preliminary Note on Investigations on 1,000 Consecutive Cases of Peripheral Nerve Injury, Brit. M. J. **2**:535 (Nov. 16) 1918.

2. Stewart, Purves, and Evans, Arthur: Nerve Injuries and Their Treatment, Oxford Medical Publications, 1916. (These authors give statistics on 316 cases of nerve injury.)

nerve only one occurred singly, that is, unassociated with the other lesions. Of the six musculo-cutaneous lesions, five occurred associated with other nerve injuries.

LESIONS OF THE LOWER EXTREMITIES

In contrasting lesions of the lower extremities, interesting comparisons arise in regard to sciatic nerve injuries. Burrow and Carter record 121 out of 1,000 cases; Stewart and Evans, 21 of their 316 cases; we have had 21 in our series of 415 cases. In regard to external popliteal involvements, the former English authorities record 97 out of their 1,000 cases, the latter 26 of their 316 cases; we have had 40 instances. Many sciatic injuries quickly resolve themselves into partial or complete involvements of the external popliteal branch, a fact commented on by Stewart and Evans. The internal popliteal escapes with an incomplete involvement, which, as emphasized by Hammond,[3] shows a marked tendency to recovery without special treatment.

As a consequence, we believe that not a few of our external popliteal involvements were really incomplete sciatic lesions in the beginning.

The English authors quoted do not record any instances of involvements of the external cutaneous nerve of the thigh; we have observed three such lesions. On the other hand, to the ten instances of anterior crural nerve involvement which their series of 1,316 cases reveal, we can only add two incomplete involvements with neuritis.

While neuromas on the whole are not frequently met with in peripheral nerve injuries, the great majority that are felt occur in the course of the median and ulnar nerves in the upper arm; a few are palpated along the course of the sciatic nerve in the thigh.

The cranial nerve injuries tabulated require no particular comment.

The clinical and symptomatological minutiae of the various nerve injuries are omitted in this paper; for such detailed clinical descriptions reference may be made to the excellent works of Mme. Athanassio Benisty,[4] Tinel,[5] and Stewart and Evans.[2]

BRAIN INJURIES

It is beside the purpose of this paper to go into the subject of brain injuries, concerning which such a vast literature has already arisen.

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3. Hammond, T. E.: The Involvement of the External and Internal Popliteal Nerves in Lesions of the Sciatic Nerve, Brit. M. J. **1**:397 (April 6) 1918.

4. Benisty, Mme. Athanassio: The Clinical Forms of Nerve Lesions (English translation), Military Medical Manuals, University of London Press, Ltd., 1918.

5. Tinel: Les Blessures des Nerfs, Masson et Cie, Paris, 1916.

Two very interesting cases coming under our notice, however, deserve mention.

ILLUSTRATIVE CASES

CASE 1 (J. H., Infantry Sergeant).—*Diagnosis: Cerebral concussion (laceration?) following severe head trauma (fracture of the base of the skull?).*

The prolonged period of amnesia—the auditory aphasia, the sudden and peculiar changes in conduct characterized by the attacks of antagonistic behavior and negativism (posttraumatic psychosis), together with the partial loss of memory, the attacks of vertigo, tinnitus, restlessness, severe headaches, and the concentric contraction of the visual fields, all denote a diffuse cerebral injury involving especially the left temporal and occipital lobes, and optic paths. Such a complex grouping of symptoms and signs renders the case of especial interest.

History.—The patient has served ten years in the U. S. Army with a good record. He was admitted to the U. S. Army Base Hospital, Camp Merritt, N. J., Feb. 11, 1919; when examined, February 19, he talked freely and gave a fairly connected history of one year's foreign service. In July, 1918, he was gassed twice. On July 15, 1918, at Chateau-Thierry during a bombardment he was severely shocked with high explosives, and was "blown up twice"; during the second explosion he came down and hit his head, but was not rendered unconscious; he was dazed and suffered from loss of speech and hearing at this time. Later that day while being taken prisoner, he was severely beaten about the head with the butts of the German guns, and from the history of others, bled from nose, mouth and ears, at this time. The patient has no recollection of anything that occurred from July 15 to early September, but the history shows that he had numerous outbreaks of irritability while in a German prison camp, getting into fights with the German prison officers and attendants.

The first indication of return of memory occurred early in September, 1918; he remembers being able to talk, "but not well"; he could see, but the letters had to be very large. At that time he was unable to understand spoken language; it was necessary to put everything in writing. Since that time the patient has gradually improved, but he has had attacks of loss of memory, preceded by vertigo, constant ringing, loud noises in both ears, mental confusion, restlessness, severe headaches, and throbbing at the temples, terminating in profuse sweating and marked weakness. Some of these attacks were associated with mental derangement. On Feb. 19, 1919, the patient while being subjected to a Bárány test, had a violent propulsive seizure, and would have fallen heavily had he not been caught. There was no past-pointing. This reaction seemed to upset him greatly, and he felt very badly for several days.

Neurologic Examination.—Motor: Negative. Gait negative.

Sensory: Negative.

Reflexes: Knee jerks, double plus; Achilles, plus; arm reflexes, plus.

Cranial Nerves: Pupils equal, react to light and accommodation. Slight nystagmus to left. Fundi: pale, outline distinct, no signs of neuritis. Hearing, apparently diminished, but the behavior of the patient suggested at this time that his difficulty in understanding was an aphasic difficulty rather than due to an inherent defect in hearing. After answering numerous questions, the patient's behavior underwent a remarkable change; he became suddenly indifferent, refused to answer, looked down, and became sullen and irritable. Further examination discontinued until February 24, when the patient was seen in the ward smoking a cigar. He refused to talk, dropped his head, seemed

quite annoyed, and was markedly negativistic. After several attempts to get him to talk he arose from his chair, advanced toward the examiner, and made an attempt at assault. He was finally quieted and told to sit down, which he did. He rested his head on a table, and then began to move it with a jerky, lateral movement, becoming quite prostrated.

On March 1, the patient was much improved, talked freely, stating that he had no knowledge of the previous visit of the examiner, in fact, he said that he had never seen the examiner before. He was surprised when told that he exhibited an antagonistic attitude on the last examination. He stated that he was subject to such outbreaks, and that "his nerves were all gone," that he cannot remember, and does not sleep well.

Examination March 6: Patient not so well, spoke freely; he remembered the examiner, and some of the conversation of the last visit. Orientation, judgment and insight good. Marked concentric contraction of visual fields; photophobia; marked tinnitus complained of, worse in left ear. Hearing not diminished. His vocabulary is very limited, his speech slow, and he mixes his words. Before answering, he repeats the questions asked of him. No dysarthria. Memory: very distinctly amnesic, with complete blotting out of certain memories. Patient shows evident psychic exhaustibility; at first he conversed very well, but toward the end of the examination, he exhibited marked evidences of mental fatigue. The patient himself notices this, remarking, "if you keep at me too long, I can't think at all."

Roentgenogram.—This reveals no evidences of fracture of the skull.

Results.—The general behavior of the patient indicates that he has considerable difficulty in understanding spoken language. He makes no attempt to reply to questions until he advances close to the examiner, and watches the latter's lips very carefully; he then replies only after repeating the question asked. (This represents an effort to correct his auditory aphasia.) This is in contrast to his spontaneous speech which is comparatively fluent and connected. Patient's emotional behavior is now of a distinctly humorous turn.

Case 2 (W. G.).—*Diagnosis: Injury to cervical cord following fracture of left transverse processes of sixth and seventh cervical vertebrae; cerebral thrombosis, left, following ligation of external carotid artery in the neck (thrombus, ascending in the internal carotid artery).*

This case is of especial interest in the unusual combination of lesions presented. Due to the cervical cord injury, we have a flaccid spinal monoplegia (left upper extremity) with sensory changes and a left cervical sympathetic paralysis with ptosis and miosis. On the other hand, incident to the cerebral thrombosis, and involvement of the vascular channels supplying the left sensory-motor areas, and motor speech center of Broca, there developed a motor aphasia, with right sided hemiplegia, hemihypesthesia, hemihypalgesia, right sided loss of muscle sense and partial astereognosis.

History.—A cerebral hemiplegia (with motor aphasia) on one side, and a spinal monoplegia with associated sympathetic palsy on the other, is certainly a rare combination. Shrapnel injury of left side of neck was sustained Sept. 28, 1918. Such a severe hemorrhage occurred at the site of injury that ligation of the external carotid artery on the left side became necessary. Two hours after the operation a right-sided hemiplegia and hemianesthesia supervened, more marked, however, in the upper than in the lower extremity. Loss of speech, with loss of power and numbness of left arm and ptosis of left upper eyelid, and miosis of left pupil also appeared.

Neurologic Examination (Dec. 15, 1918).—This revealed the following:

Motor: There is weakness of right arm, and to a lesser extent, the right leg. A marked weakness exists in the left arm, but none in the left leg. Grips: left, weak; right, weak (but stronger than left). No atrophy of definite muscle groups. Gait: slightly hemiplegic on right. Some spasticity of right hand and arm. Limitation of forward movements of cervical spine.

Sensory: Hypesthesia, hypalgesia, loss of muscle sense, and partial astereognosis noted in right upper extremity, more marked in the distal part. Sensation of right lower extremity, normal. Hypesthesia and hypalgesia present in the upper extremity—more marked than on right side. There is tenderness of seventh cervical spine.

Reflexes: Knee jerks: right, double plus; left, normal. Achilles: right, active; left, normal. Babinski present on right. Arm reflexes: right increased; left, normal.

Cranial Nerves: There is a left partial ptosis, associated with a pupillary miosis. Fundi: white patches of choroidal atrophy present in both eyes adjacent to the disks. Speech: A distinct paraphasia is present which apparently is the residuum of the previous motor aphasia. There is considerable difficulty in pronouncing "g's," "p's," and "c's" (dysarthria). Memory shows marked defect.

Roentgen-Ray Findings (Dec. 28, 1918).—Loss of bony tissue in the region of the left transverse processes of the sixth and seventh cervical vertebrae.

SPINAL CORD INJURIES

As will be noted in Table 3, four cases of hematomyelia are recorded. In view of the late work of H. Claude and J. Lhermitte,[6] the propriety of designating these cases as "hematomyelia" is seriously questioned. These authors, in a recent article describing similar injuries in the French soldier, emphasize the factor of concussion in the production of the pathology and classify their cases as (*a*) *Indirect Conclusion:* This results from the explosion of shells of large caliber at a distance producing marked variations in atmospheric pressure; the individual affected is not struck by the missile. (*b*) *Direct Concussion:* (1) Immediate — in which the missile passes through the body of the vertebrae, or fractures the transverse or spinous processes, and (2) mediate — in which the missile passes through perispinal tissues or impinges on neighboring bones, so producing concussion of the cord tissues.

Both in the mediate and immediate types of direct concussion, the clinical syndromes produced are identical; all degrees and grades of pathologic phenomena may be brought about in these two types of direct concussion. The French authors[7] emphasize the absence of

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6. Claude, H., and Lhermitte, J.: Les Commotions directes de la Moelle Epiniere, Presse Med. **26**:514 (Oct. 7) 1918.

7. Claude, H., and Lhermitte, J.: Etude clinique et anatomique de la Commotion directe de la Moelle Epiniere, Ann. de Med. 2:479 (Nov.) 1915.

hemorrhage in these direct concussion cases, and refer to the pathology in the cord as one of necrosis of nerve cells, axis-cylinders, and myelin sheaths, affecting the white fibers much more than the gray matter, and involving the central canal and posterior roots often to a remarkable degree. Neuroglia, vascular and other connective tissue elements show active proliferation. The following patients (Cases 3 to 8) are examples illustrative of the direct type of concussion, although tabulated by us in part as instances of hematomyelia. It will be noted that Cases 3, 4, 5 and 7, represent the immediate types of direct concussion, whereas Cases 6 and 8 illustrate the mediate variety.

CASE 3 (I. S.)—*Diagnosis: Injury to fifth dorsal segment of spinal cord following fracture of lamina of fifth dorsal vertebra and the right transverse processes of sixth and seventh dorsal vertebrae.*

The trauma produced a paraplegia with bladder and rectal disturbances, which recovered to a remarkable degree and sensory changes, which were of the dissociated type seen in syringomyelia. This case not only illustrates the great degree of recovery attainable in these cases, but also shows how the brunt of the pathologic process may be borne by the tissues about the central canal of the cord.

History.—Gunshot wound, July 21, 1918, penetrating right side and back of chest with comminuted fracture of sixth and seventh ribs, with injury to fifth and sixth dorsal vertebrae.

Previous examinations made abroad give the following data (from soldier's field card) July 29, 1918: "Paraplegia: right side, complete; left, nearly so. Roentgen ray reveals foreign body above left scapula, nearly subcutaneous. Fracture of eighth rib at entrance wound; fifth, sixth and seventh ribs near the spine. Fracture of transverse process, right side dorsal sixth and seventh vertebrae. Fracture lamina of fifth dorsal vertebra. Bladder and rectal control not lost, but disturbed. Hydropneumothorax present."

Aug. 18, 1918: "Power returning in legs; bladder and rectum the same. Incontinence of urine and feces, anesthesia of urethra, bladder, and rectum of two months' duration."

Neurologic Examination (Feb. 20, 1919).—This revealed the following:

Motor: No weakness of lower extremities. Gait, normal.

Sensory: Complete thermo-anesthesia, hypesthesia and analgesia below the level of fifth dorsal cutaneous segment with retention of deep sensation, except over buttocks, where there are two areas (islands) of retained heat sensibility. (Dissociation of sensation.)

Reflexes: Both knee jerks quite exaggerated. Patellar clonus on left side. No ankle clonus. Babinski and Oppenheim present on both sides. Although analgesic, when stuck with a pin, a marked motor reflex occurs in extensor muscles of both thighs, showing irritability of pyramidal tracts. A very slight Romberg. Marked *cutis anserinus* present, ephemeral in character.

Cranial Nerves: Negative.

Roentgen-Ray Findings (Feb. 23, 1919).—There is a comminuted fracture through the sixth and seventh ribs near the vertebral ends on the right side, with fractures of the transverse processes of the fifth and sixth dorsal vertebrae. There are some small fragments of metal near the fifth rib.

CASE 4 (E. M.).—*Diagnosis: Injury of the cauda equina, following fracture of the fifth lumbar vertebra.*

This produced a paraplegia with bladder and rectal disturbances, pains and tenderness along the sciatic nerves (descending neuritis) and a bilateral segmental loss of sensation in the entire sacral distribution. In this case the recovery attained is not as pronounced as in the preceding one. The presence of tenderness along the left sciatic nerve indicative of a descending neuritis is of especial interest.

History.—Gunshot wound in lower back sustained Oct. 14, 1918, followed by paralysis and numbness of lower extremities, retention of urine and marked constipation, associated with anesthesia of rectum, urethra, and bladder. After a period of two weeks, partial return of vesical and rectal power together with return of power in flexors and extensors of both thighs occurred; return of sensation also made its appearance on anterior aspect of both thighs. With numbness and paresthesia, shooting pains radiated down both sciatic nerves, the latter persisting on the left side. Movements of toes and dorsiflexion of feet, especially right, then partially returned. Loss of power of erection persisted for three months.

Neurologic Examination (Feb. 14, 1919).—This revealed the following:

Motor: Atrophy of glutei, calf, anterior tibial and peroneal muscles on both sides; weakness more marked on left side. Bilateral weakness of dorsi-flexors of feet especially marked on left side, producing partial bilateral "drop-foot." Gait, typically "steppage."

Sensory: Anesthesia and analgesia in cutaneous distribution of all sacral segments; anesthesia of urethra, bladder, and rectum. The first and second sacral segmental areas show irregular patches of return of sensation, more marked on right side; left sciatic nerve tender.

Reflexes: Abdominal, active and equal. Cremasteric, active and equal. Knee jerks, right, active; left, diminished. Achilles, both lost. Upper extremities normal.

Roentgen-Ray Findings.—The fifth lumbar vertebra shows a fracture of the left side of its body with a loss of bony substance 2½ by ½ cm., without dislocation or compression.

CASE 5 (A. L.)—*Diagnosis: Injury to cauda equina following fracture of the fifth lumbar vertebra producing a syndrome of greater severity than in the instance of the preceding case. Paraplegia, muscular fibrillations, bilateral segmental loss of sensation in the sacral distribution of an assymetrical nature, associated with trophic disturbances in foreskin and glans penis, are present. The descending neuritis in the sciatic nerves is very severe, occupying a prominent place in the clinical picture.*

History.—Sustained a shrapnel wound of the fifth lumbar vertebra in September, 1918, following which he developed paralysis and numbness in the entire left leg and thigh, muscular twitchings in both legs and thighs, and retention of urine and feces. About ten days later, urinary incontinence took the place of retention. He gradually improved, was able to walk, and was sent back to this country.

Neurologic Examination (Feb. 1, 1919).—This revealed the following:

Motor: Atrophy of the muscles of both buttocks (glutei) especially left; atrophy of left hamstring muscles. Marked muscular twitchings in muscles of both thighs and legs, and also to a lesser extent in the muscles of the arms and forearms.

Sensory: Touch, deep pressure, pain and temperature absent in the cutaneous distribution of the left sacral 2-3-4-5 and coccygeal 1 segments, and in the cutaneous distribution of the right sacral 3-4-5 and coccygeal 1 segments. This involves the penis and the left half of scrotum, which are anesthetic and analgesic. The right half of the scrotum is hypesthetic. Trophic disturbances are manifested in foreskin and glans penis. There is anesthesia of rectum, bladder and urethra.

Hyperesthesia and hyperalgesia of skin along spinal column up to the level of the cervical spine. Sharp pain radiating down both thighs and legs into soles of both feet occurs, much more severe on the left, on which side it is associated with marked dysesthesia. Pressure along left calf and thigh is productive of severe pain.

Reflexes: Knee jerks, equal and active. Both Achilles absent. Upper extremities exagerated.

Cranial Nerves: Negative. Incontinence of urine and persistent constipation present.

Roentgen-Ray Report (Feb. 4, 1919).—There is a piece of shrapnel 2½ cm. long and 1 to 1½ cm. wide resting above the left sacro-iliac joint. The bone is apparently normal beneath. Another small fragment 1 cm. long and ½ cm. wide is located 1 cm. from the left border of the fifth lumbar and first sacral vertebrae. There has been some bone destruction on the left border of the body of the fifth lumbar vertebra, and a piece of bone about 1 cm. long is missing. This destruction of bone lies almost directly above the location of the smaller foreign body; there has been a deposit of inflammatory tissue about this area. There is no other evidence of fracture of this vertebra and no compression present.

Case 6 (R. P.).—*Diagnosis: Injury to conus terminalis producing the "conus terminalis syndrome."*

The bilaterally symmetrical ano-genital anesthesia (sacral fourth and fifth segments) with complete retention of urine, occasional fecal incontinence, sexual impotence, together with the absence of pain and quick disappearance of fibrillations make for a clean cut clinical picture.

History.—Sustained gunshot wound Sept. 6, 1918, entering left hip, passing across region of first and second sacral vertebrae, emerging at right hip. At the time of injury, partial paralysis of both legs, with muscular twitchings of lower extremities—retention of urine, loss of rectal control, and loss of power of erection occurred.

Neurologic Examination (Dec. 31, 1918).—This revealed the following:

Motor: Walking slow and difficult; gait, straddle-legged and paretic, though no actual paralysis. Muscular twitchings have disappeared.

Sensory: Anesthesia and analgesia of penis, scrotum, perineum, bladder, urethra and rectum; also, a band of anesthesia extending around the lower abdomen and the inner aspect of thighs, above which was an area of hyperesthesia. The sensory changes are symmetrical. Except for constant backache, no pains are complained of.

Reflexes: Knee jerks, equal and active. Cremasteric, present, left greater than right. Abdominals, equal and active. Upper extremities, normal.

Cranial Nerves: Negative. Complete retention of urine, necessitating catheterization, present together with marked constipation, and occasional fecal incontinence.

Reexamination (Jan. 11, 1919): Examination at this time revealed:

Motor: No change.

Sensory: Area of anesthesia diminishing; and limited to the cutaneous distribution of the fourth and fifth sacral segments on both sides. Hyperesthetic areas above first lumbar regions still present.

Reflexes: No change.

Retention of urine, persistent constipation with occasional fecal incontinence, impotence, and anogenital anesthesia still present.

Roentgen-Ray Examination.—Reveals no injury of bones of lower spine.

CASE 7 (R. M.).—*Diagnosis: An unusual case of concussion (hematomyelia?) of cervical cord, produced by injury to the spinous processes of fifth and sixth cervical vertebrae.*

The involuntary, painful, muscular contractures of the fingers, the atrophy of the muscles of the upper extremities, the dysesthesiae and parasthesiae, and other sensory and trophic disturbances, all of a symmetrical nature constitute a very interesting and rare syndrome. These irritative manifestations are dependent, we believe, on lesions of the posterior roots and columns, pyramidal tracts and anterior columns of a partially destructive nature.

History.—Gunshot wound of neck sustained in October, 1918. The missile entered the left side of neck, passed horizontally across the median line, emerging at a corresponding point on right side, the scars of injury being on the level of the spinous process of the fourth cervical vertebra.

Following the injury, the patient suffered a complete motor paralysis of upper and lower extremities and a sensory paralysis of the upper extremities; the lower extremities gradually regained their motor power.

Neurologic Examination (Dec. 21, 1918).—This revealed the following: Marked tenderness to pressure over the fifth and sixth cervical vertebrae over which spinous processes there is a loss of the usual bony contour. The superficial fibers of both trapezii have been severed. Lateral movements of head restricted and painful. A marked, painful flexor contracture of fingers of both hands present, producing an involuntary clenching; the palms show as a consequence the imprint of the finger-nails. He complains of marked tenderness of skin of hands, of paresthesiae, and of severe painful cramps in muscles of hands.

Motor: Weakness of both upper extremities, more marked distally; especially flexors of forearm and intrinsic muscles of hands with consequent limitation of the finer movements of fingers and hands. Atrophy of muscles of both shoulders, arms, forearms and hands; grips, weak—left weaker than right. No fibrillary twitchings; a fine rapid tremor of hands is present; the contractures are noted above.

Sensory: Skin of hands very tender and intolerant to cold; areas of dysesthesia, hypesthesia, hypalgesia and thermohyperesthesia of hands and forearms. Trophic: skin pink, glossy and dry. Astereognosis: left complete, right partial.

Reflexes: Deep reflexes of lower extremitities, normal. Upper extremities, left arm, increased; right arm, normal.

Cranial Nerves: Pupils contracted, outline regular, light reaction diminished. Fundi show marked congenital conus.

Roentgen-Ray Findings.—There is destruction of spinous processes of fifth and sixth cervical vertebrae. The bodies of the vertebrae are apparently normal. The ligamentum nuchae has been partially severed.

Case 8 (A. W.).—*Diagnosis: Injury to cervical and dorsal cord (cervical fifth to dorsal second segments) following gunshot wound of neck.*

In this case there is no evidence of direct (immediate) injury to the vertebral column and yet the concussion of perispinal tissues was transmitted to the cord in such a violent manner as to produce a distinct segmental injury (C_5 to D_2) which manifests itself in the muscular atrophy of the left shoulder group, in a left sympathetic ptosis and myosis (which disappeared) and in a Brown-Séquard syndrome involving the left half of the cord in the cervico-dorsal region.

History.—Shrapnel wound of left side of neck sustained Oct. 1, 1918, situated behind the posterior border of sterno-mastoid muscle of left side, 3½ inches below the tip of the mastoid process, producing loss of power of left arm, leg, and partial loss of power of right leg with loss of sensation of right side of body, including arm, leg, and trunk. He was not unconscious, but there was considerable bleeding from the wound. At this time there was also noticed a drooping of his left upper eyelid, and a contraction of the left pupil. Twenty hours after the injury the patient was operated on and a piece of shrapnel, with particles of clothing were removed; following the operation loss of voice and dysphagia appeared (injury of left recurrent laryngeal nerve) Five days later wound culture showed *Bacillus welchii* and nonhemolytic streptococci.

Patient progressively improved and was finally sent back to this country. He was admitted to U. S. Army Base Hospital, Camp Merritt, N. J., Feb. 21, 1919, suffering from marked dyspnea; examination then showed such edema of larynx and glottis that a low tracheotomy had to be performed; prompt relief followed.

Neurologic Examination (Feb. 23, 1919).—This revealed: A purulent discharge from the operative wound which now evidently communicated with the tract of the missile; subcutaneous emphysema noted in both supraclavicular spaces. Lateral movements of head limited and painful; tenderness over spinous processes of cervical vertebrae.

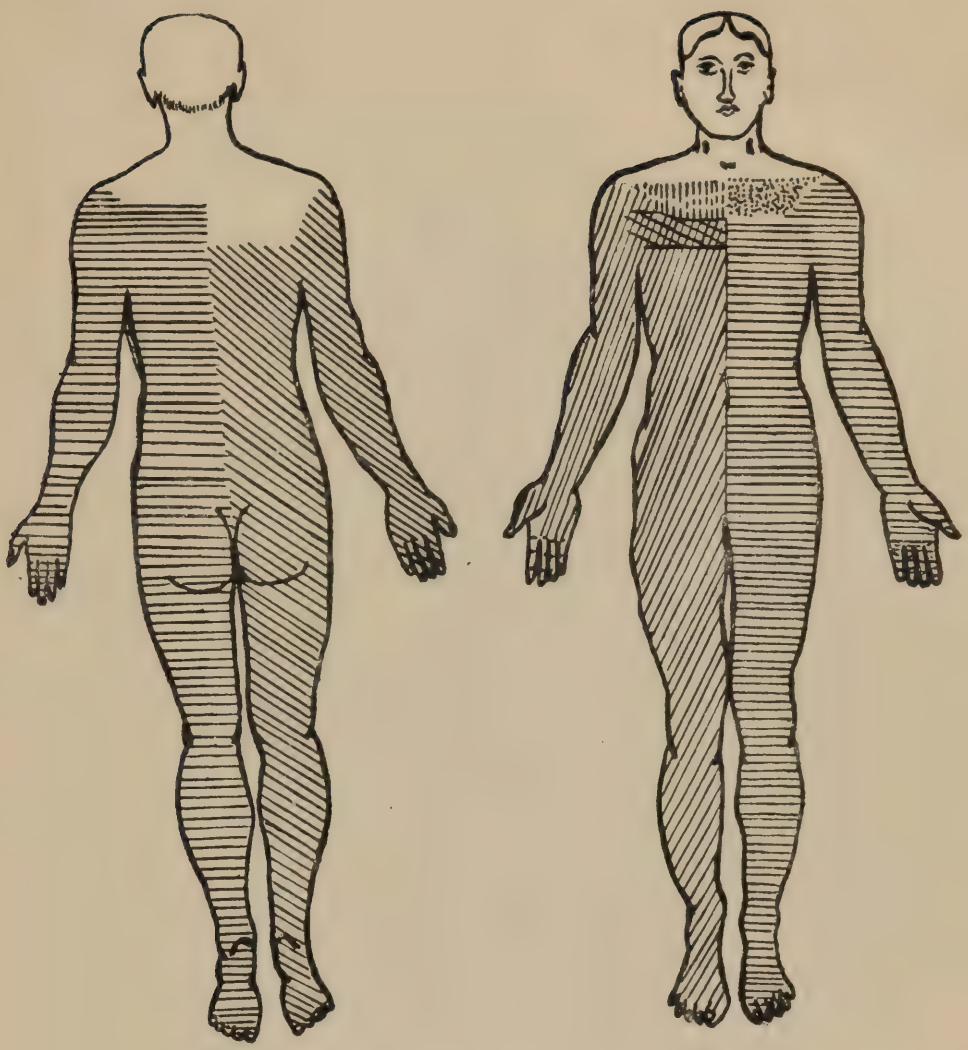
Motor: Weakness of left arm (especially muscles of shoulder group) and of left leg. Right upper extremity, normal; right lower, weak. Grips: left, weak; right, normal. Considerable atrophy of left supraspinatus, infraspinatus, deltoid, biceps, pectorales, trapezius, and to a lesser degree, of the muscles of left forearm and hand. Some weakness of both lower extremities, not enough to prevent efficient locomotion.

Sensory: Refer to the accompanying chart.

Reflexes: Knee jerks: right, active; left, double plus. Achilles reflex, right, active; left, double plus. Ankle and patellar clonus present on left, on which side there is also a Babinski. Biceps and triceps are normal on the right, but increased on the left. Abdominals and epigastrics, normal on the right, absent on the left.

Cranial Nerves: Negative. Left sympathetic ptosis and pupillary miosis now gone.

Roentgen-Ray Findings.—This was negative for bony changes in cervical spine (March 20, 1919). Pain and temperature sense have returned on the right side, down to the level of the fourth intercostal space.



Illustrating sensory changes in Case 4.8

1. Area of hypesthesia; deep sensation retained.

2. Area of analgesia, thermo-anesthesia and hypesthesia; the hypesthesia is less marked on this side.

3. Area of thermohypesthesia, hypalgesia and hypesthesia.

4. Area of thermohypesthesia, hyperalgesia and hyperesthesia.

5. Area of thermohypesthesia. Areas 3, 4 and 5 not well differentiated on back.

FUNCTIONAL CASES

Herewith are presented three cases of a functional nature, each peculiarly interesting in certain of its features.

CASE 9 (N. B. M.).—*Diagnosis: Concussion of lumbar cord producing a paraplegia with sensory changes and bladder disturbances.*

As the organic lesion was recovering, a functional condition developed, characterized by clonic tic-like movements of face and upper part of body, emotional instability, headaches, left sided hemianesthesia, hemianalgesia, and "glove and stocking" anesthesia and analgesia on the right side.

History.—This patient was "blown down" while in a barrage and fell headlong into a shell hole, producing marked hyperextension of his spinal column. Following this he was dazed and his lower extremities felt numb and paralyzed; he was unable to move them for about ten days, when motion gradually returned. Incontinence of urine was present and has persisted. It consists of an inability to control the flow. There is no retention or loss of bowel control. The patient also complained of a dull constant pain in the lower back, with radiations of a sharp nature encircling the abdomen, at the level of the iliac crests, and also stiffness of lower extremities.

Neurologic Examination (Dec. 19, 1918).—This revealed the following: Motor: Great difficulty in walking noted, due to pain and stiffness of back.

Sensory: Irregular areas of hypesthesia and hypalgesia over entire body; a band of hyperesthesia in lower dorso-lumbar region extends around the trunk.

Reflexes: Knee jerks, equal but diminished. Achilles, present and equal. Pupils, irregular—react to light and accommodation.

The spinal column is so rigid that he cannot bend over. He complains of marked restlessness, headache, vertigo, and poor vision.

Subsequent Examination.—More recently, since the latter part of December, 1918, clonic irregular, tic-like movements of neck and shoulders occur. These movements are much worse on emotional excitement, hearing noises, etc. He is still subject to headache (whereas formerly he was quite immune); he is emotionally unstable, weeping readily. His speech is quite hesitating, whereas formerly he was able to discourse freely. Facial grimaces and movements occur now, whereas formerly they did not. He complains of "specks" before his eyes, and cold feet quite frequently.

Ten years ago he had an attack of "nervous prostration," which lasted over a period of six months; he was confined to his bed for the first six weeks. The attack was ushered in by unconsciousness, associated with muscular movements of an involuntary nature on the right side of body, and partial loss of memory. He finally made a good recovery.

Reexamination (Jan. 22, 1919).—Examination at this point revealed the following:

Motor: He walks with a shuffling, spastic gait, holding his back quite rigid. No muscular atrophy or hypertonicity.

Sensory: Complete *left-sided* hemianesthesia and hemianalgesia.*

On *right side* anesthesia and analgesia of lower extremity up to groin, and of lower third of right forearm and hand. Tenderness in lower back.

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* Along inner sides of both legs there remains a longitudinal, narrow area of retained sensation.

Reflexes: Knee jerks, both diminished. Achilles present and equal. No Babinski or Oppenheim.

Final Results.—Later reports from U. S. Army General Hospital No. 1, New York, to which this patient was transferred, indicate that he has almost entirely recovered from his functional disturbances.

CASE 10 (J. W.).—*Diagnosis: Hysterical monoplegia, with "glove" anesthesia and analgesia associated with a homolateral hemihypesthesia and hemihypalgesia following a gunshot wound of left forearm.*

This case illustrates the "fixing" of a hysterical monoplegia by a gunshot wound of the same limb.

History.—Gunshot wound of left forearm, 3½ inches below the elbow, sustained July 21, 1918.

Neurologic Examination (Jan. 20, 1919).—This revealed a functional paralysis of all the muscles of the left forearm and hand; all electrical reactions preserved; no demonstrable organic nerve lesion. Slight degree of atrophy (disuse) in muscles of left forearm and hand. Complete "glove" anesthesia and analgesia to 1½ inches above site of wound, associated with which there exists a left hemihypesthesia and hemihypalgesia.

CASE 11 (J. G.).—*Diagnosis: Hysterical "glove" anesthesia and analgesia following a trivial injury (gunshot wound) of the little finger of the left hand.*

The interest in this case centers about the fact that as the sensory changes began to disappear, the area of anesthesia remaining very closely simulated the cutaneous sensory distribution of the ulnar nerve in the hand.

History.—This soldier gives a history of having been gassed and "shell shocked" before sustaining a gunshot wound of the little finger of the left hand on July 15, 1918; this injury was very evidently of a trivial nature. The history shows that for six weeks after the injury there was a complete "glove" anesthesia and analgesia to above the left wrist. This gradually cleared up.

Neurologic Examination.—When examined by us Feb. 6, 1919, the functional area of anesthesia remaining very closely simulated the sensory distribution of an ulnar area of organic origin. A complete left hemihypesthesia and hemihypalgesia was also present. He complains of insomnia, headaches, partial loss of memory and general nervousness, with inability to stand excitement or hear noises "without jumping."